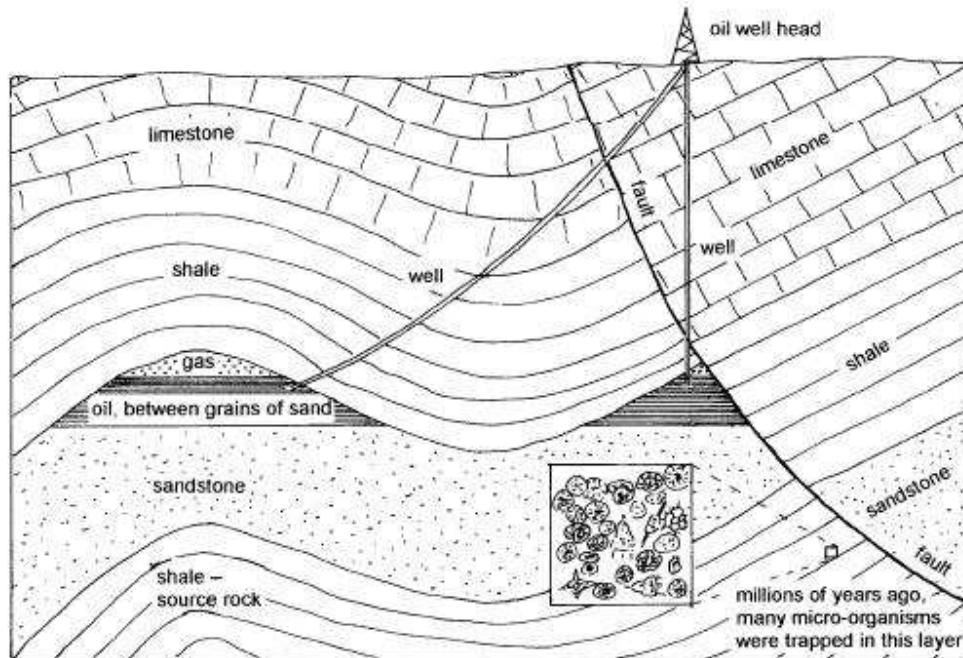


## Where shall we drill for oil? Sorting out the sequence - oil prospect



Show the pupils the diagram. Explain that it is a cross-section, or slice, through the ground. The oil well-head will help them to understand the scale. Explain that the diagram shows how oil and gas are formed and how they become trapped in the ground. It also shows how they may be extracted (taken out for use).

### Ask the pupils:

- To list the events in the correct order starting with the oldest, i.e. the first thing to happen. Give them the sentences written opposite. The sentences are best written on strips of paper and cut out for the pupils to arrange.
- How might oil and gas escape from the trap on the right?
- What would have happened if the fault had brought the limestone on the right into contact with the sandstone on the left?
- What sorts of rock would they be looking for if they were searching for oil and gas?

### Sentences:

- Sandy sediments are deposited and will become porous, permeable oil/gas containing reservoir rock
- Oil migrates to a trap (natural underground storage area)
- Plankton in the sea use sunlight to photosynthesise and grow
- Borehole finds oil
- Deformation (folding/faulting) of sediments produces a trap
- Heat and increased pressure release oil from plankton-rich sediments
- Plankton die, sink and become part of sea floor sediments, which will become the source rock
- Muddy sediments are deposited and will become impermeable cap rock

### The back up:

**Title:** Where shall we drill for oil?

**Subtitle:** Sorting out the sequence - oil prospect.

**Topic:** Oil and gas formation, storage underground and exploration.

**Age range of pupils:** 12 - 18 years.

**Time needed to complete the activity:** 20 minutes.

**Pupil learning outcomes:** Pupils can:-

- explain how oil and gas form;
- explain how oil and gas become trapped and sealed in;
- define the words porous, permeable and impermeable;
- record the sequence of events shown starting with the oldest;

- interpret cross-section diagrams of rocks;
- realise that it takes millions of years to form oil/gas;
- suggest suitable places to explore for oil and gas.

**Context:** This could form part of a lesson on the Earth's resources, leading to a discussion of world energy supplies, or a lesson on sequencing geological events. It might follow an introduction to the stratigraphic principles, such as in the Earthlearningidea 'Laying down the principles'.

- List the events in the correct order starting with the oldest, i.e. the first thing to happen.
- Oldest event - Plankton in the sea use sunlight to photosynthesise and grow. *Plankton are small or microscopic plants (phytoplankton) and animals (zooplankton) that float or drift in great numbers in either fresh or sea water. The phytoplankton use the energy in sunlight (through photosynthesis) to convert water and carbon dioxide into carbohydrates and oxygen.*
- Plankton die, sink and become part of sea floor sediments, which will become the source rock. *The source rock is the name given to the rock which will eventually contain the hydrocarbons which will be oil and gas. In the diagram the source rock is 'shale' a compressed mudstone.*
- Sandy sediments are deposited and will become porous, permeable oil/gas containing reservoir rock. *A reservoir rock is one which can store oil and gas in the pore spaces between the grains.*
- Muddy sediments are deposited and will become impermeable cap rock. *This is another shale on the diagram. This rock is impermeable, meaning that it will not let liquids pass through it. It will seal in (cap) any oil and gas trapped in the rock below.*
- Deformation (folding/faulting) of sediments produces a trap. The folding/faulting of the rocks may be caused by tectonic plate movement. *The sequence of sediments shown - shale, sandstone, shale and limestone, were all folded. The upfolds produced traps from which the oil and gas cannot escape.*
- Heat and increased pressure release oil from plankton-rich sediments. *The heat and increased pressure, often experienced during the folding of the rocks, causes the oil and gas to be released from its source rock.*
- Oil migrates to a trap (natural underground storage area). *The oil and gas move upwards from the shale source rock through the pore spaces of the sandstone to the tops of the folds from where they cannot escape because of the impermeable cap rock.*
- Youngest event - Borehole finds oil.
- How might oil and gas escape from the trap on the right? *The oil and gas could escape to the surface along the fault line.*

- What would have happened if the fault had brought the limestone on the right into contact with the sandstone on the left? *The oil and gas would not have been trapped in the sandstone. It would have moved upwards into the limestone which is also porous and permeable.*
- What sorts of rock would they be looking for if they were searching for oil and gas? *All the rocks would be sedimentary. Porous, permeable sedimentary rock is needed for the reservoir but there must also be a source rock, a suitable trap and a cap rock. Satellite maps and investigative boreholes are used to find oil and gas.*

**Following up the activity:** Try the Earthlearningidea activity about an oil gusher. Other resources could be investigated e.g. coal. World energy resources could be discussed. Other sequencing activities could be undertaken in the classroom, the surrounding area, or at rock exposures.

#### **Underlying Principles:**

- oil and gas are only retained when there is a source rock, sufficient heat and pressure, a reservoir rock, a cap rock and a trap.
- upfolds (anticlines) in rocks are the most common form of trap.
- unless the rocks have been overturned, the rock at the bottom of the sequence is the oldest.
- oil and gas are non-renewable resources; they take millions of years to form.

#### **Thinking skill development:**

- appreciation of the time pattern (construction).
- why oil cannot be released before the trap forms (cognitive conflict).
- reasoning behind the answers (metacognition).
- recognising that similar rocks elsewhere may be worth exploring for oil/gas (bridging).

#### **Resource list:**

- diagram
- sentences written on strips of paper (optional)

#### **Useful links:**

<http://www.fi.edu/fellows/fellow2/jan99/oilreservoirs.html>  
<http://www.geologyshop.co.uk/oil&ga~1.htm>  
[http://geolor.com/geoteach/SubmergeEmerge/Tell\\_the\\_Story\\_of\\_Rock\\_Sequences-Earth\\_Science\\_Assignment.htm](http://geolor.com/geoteach/SubmergeEmerge/Tell_the_Story_of_Rock_Sequences-Earth_Science_Assignment.htm)

**Sources:** Devised for an Earth Science Education Unit workshop by Chris King of the Earthlearningidea team.

## Earthlearningidea

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